WHAT IS CLAIMED IS:

1. A spatial and temporal equalizer comprising:

an adaptive array antenna which complex-multiplies array antenna output signals from an array antenna composed of L elements by tap coefficients of adaptive array antenna to control the amplitudes and phases of received signals, and combines the multiplied output signals into an array antenna composite signal, said L being an integer equal to or greater than 2;

a feed forward filter comprising a transversal filter of N taps respectively weighted by tap coefficients of feed forward filter, for receiving said array antenna composite signal and outputting signals of the N taps as a first tap input signal and a filtering output signal, said N being an integer equal to or greater than 2;

an adaptive equalizer which has a replica generator of M taps respectively weighted by tap coefficients of adaptive equalizer, outputs, as a second tap input signal, signals from the M taps of said replica generator supplied with symbol sequences, and outputs an estimation error signal for a received symbol based on the output from said adaptive equalization circuit and a decision symbol signal, said M being an integer equal to or greater than 1;

first tap coefficient calculating means for calculating said tap coefficients of adaptive array antenna and said tap coefficients of adaptive equalizer from said array antenna output signal, said second tap input signal and said estimation error signal;

second tap coefficient calculating means for calculating said tap coefficients of feed forward filter and said tap coefficients of adaptive equalizer from said first and second tap input signals and said estimation error signal;

tap coefficient select means for selectively outputting either said tap coefficients of adaptive equalizer from said first tap coefficient calculating means or said tap coefficients of adaptive equalizer from said second tap coefficient calculating means; and

receiving quality estimating means for causing said first and second tap coefficient calculating means to repeat their convergence operation until it is estimated that the receiving quality has reached a desired level.

2. The spatial and temporal equalizer of claim 1, wherein said receiving quality estimating means is a means for deciding whether said receiving quality has reached a predetermined level by making a check to see if said estimation error signal is smaller than a predetermined value.

3. The spatial and temporal equalizer of claim 1, wherein said receiving quality estimating means is a means for deciding that said receiving quality has reached a predetermined level by repeating convergence operations of said first and second tap coefficient calculating means twice or a predetermined larger number of times.

4. The spatial and temporal equalizer of claim 1, wherein said replica generator comprises: M multipliers supplied with symbol sequences, for multiplying these symbols by said tap coefficients of adaptive equalizer, respectively; and a combiner for combining the multiplied outputs from said M multipliers to provide the combined output as a replica for said received symbols; and said adaptive equalizer comprises: a subtractor for outputting the difference between said filtering output signal and said replica as said estimation error signal; a maximum likelihood estimator for generating a symbol sequence candidate, for making a maximum likelihood estimation based on said estimation error signal to output a decision symbol; a training signal memory with a predetermined symbol sequence stored as a training

signal; and a switch which selects said training signal read out of said training signal memory in a training signal period of a received signal, selects said symbol sequence candidate from said maximum likelihood estimator in a data signal period of said received signal and provides said selected symbol sequence candidate to said replica generator, and provides said selected symbol sequence candidate as said first tap input signal to said first and second tap coefficient calculating means.

5. The spatial and temporal equalizer of claim 4, wherein said maximum likelihood estimator generates, as said symbol sequence candidate, a symbol sequence composed of M symbols preceding the current point in time.

6. The spatial and temporal equalizer of claim 4, wherein let $m_1$ and $m_2$ be integers equal to or greater than 1, said maximum likelihood estimator generates, as said symbol sequence candidate, a symbol sequence composed of a total of M symbols including $m_1$ future symbols and $m_2$ symbols covering from current time point to a past time point.

7. The spatial and temporal equalizer of claim 1, wherein said replica generator comprises: a plurality of cascade-connected delay elements each having a delay time equal to a symbol period; a plurality of multipliers for multiplying the outputs from said delay elements by said tap coefficients of adaptive equalizer, respectively; a combiner for combining the outputs from said multipliers; a first subtractor for providing the difference between the output from said combiner and said filtering output signal; a decision device for deciding the level of the output from said first subtractor to output said decision symbol; a second subtractor for providing the difference between said decision symbol and said first subtractor output as said estimation error signal; a training signal memory for storing a training signal of a predetermined

symbol sequence; and a switch which sequentially selects symbols of said training signal from said training signal memory in a training signal period of a received signal, selects said decision symbol in a data signal period of said received signal, and provides selected symbols to said cascade connection of said delay elements.

8. The spatial and temporal equalizer of any one of claims 4 to 7, wherein said adaptive array antenna comprises demodulators for demodulating received signals from said L-element array antenna, and array antenna output combining means which complex-multiplies the demodulated outputs from said demodulators by said tap coefficients of adaptive array antenna, combines the multiplied outputs into said array antenna composite signal.

9. The spatial and temporal equalizer of claim 8, which further comprises received signal storage means for temporarily storing the demodulated received signals of said demodulators, and wherein processing by said first and second tap coefficient calculating means is performed for demodulated signals read out of said received signal storage means.

10. The spatial and temporal equalizer of any one of claims 2 to 7, wherein said adaptive array antenna comprises array antenna output combining means for complex-multiplying received signal from said L-element array antenna by said tap coefficients of adaptive array antenna and for combining the multiplied outputs, and a demodulator for demodulating the combined output and for outputting the demodulated output as said array antenna composite signal.

11. The spatial and temporal equalizer of claim 10, which further comprises received signal storage means for temporarily storing received signals from said array antenna, and wherein processing by said first and second tap coefficient calculating means is performed for received signals ad

out of said received signal storage means.

12. A spatial and temporal equalization method which compensates for symbol timing offset in the output from an adaptive array antenna having array antennas by a feed forward filter and makes a symbol decision by an adaptive equalizer, said method comprising the steps of:

(a) calculating tap coefficients of adaptive array antenna for the outputs from said array antennas and tap coefficients of adaptive equalizer for said adaptive equalizer based on received signals from said array antennas and a first tap input signal and an estimation error signal from said adaptive equalizer;

(b) calculating tap coefficients of feed forward filter for respective taps of said feed forward filter and said tap coefficients of adaptive equalizer for said adaptive equalizer from a second tap input signal provided from tap outputs of said feed forward filter, said first tap input signal and said estimation error signal;

(c) calculating an estimation error in said adaptive equalizer through the use of said tap coefficients of adaptive array antenna, said tap coefficients of feed forward filter and said tap coefficients of adaptive equalizer calculated by said steps (a) and (b); and

(d) deciding whether said estimation error is smaller than a predetermined value, and if not smaller, repeating said steps (a) and (b).

13. A spatial and temporal equalization method which compensates for symbol timing offset in the output from an adaptive array antenna having array antennas by a feed forward filter and makes a symbol decision by an adaptive equalizer, said method comprising the steps of:

(a) calculating tap coefficients of adaptive array antenna for the outputs from said array antennas and tap coefficients of adaptive equalizer for said

adaptive equalizer based on received signals from said array antennas and a first tap input signal and an estimation error signal from said adaptive equalizer;

(b) calculating tap coefficients of feed forward filter for respective taps of said feed forward filter and said tap coefficients of adaptive equalizer for said adaptive equalizer from a second tap input signal provided from tap outputs of said feed forward filter, said first tap input signal and said estimation error signal; and

(c) deciding whether the number of repetitions of said steps (a) and (b) has reached a predetermined value larger than 2, and if not, repeating said steps (a) and (b).

14. The spatial and temporal equalization method of claim 12 or 13, wherein said steps (a) and (b) are steps of performing operations in first and second halves of a training signal period of a received signal.

15. The spatial and temporal equalization method of claim 12 or 13, which further comprises a step of storing a burstwise received signal in storage means, and wherein said steps (a) and (b) are steps of reading out the same training signal period of the received signal from said storage means and performing operations.

16. The spatial and temporal equalization method of claim 12 or 13, wherein: during the tap coefficient convergence processing in said step (a) said feed forward filter is set in its simply-passing state; and during the second tap coefficient convergence processing in said step (b) said tap coefficients of adaptive array antenna calculated in said step (a) are fixed, said tap coefficients of adaptive equalizer are set at initial values and said tap coefficients of feed forward filter and said tap coefficients of adaptive equalizer are calculated.